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ABSTRACT

This report describes a study conducted to determine if there were any applicable effects from private-school competition on public-school student achievement in North Carolina. The study examined multiple student outcomes, including elementary and secondary student achievement results, student dropout rates, and high school student achievement results analyzed by ethnicity. The data were aggregated at three levels (district, county, and unified county) to account for educational market particulars and competition between school districts in those areas where additional public-school choice was available. The study found no indication of significant private-school competition effects for North Carolina public-school outcomes. Following an introduction, the report provides a brief review of previous research. The next section discusses the role of competition and provides two possible mechanisms through which private-school competition might influence public-school behavior. Subsequent sections highlight the basic empirical issues involved in empirical estimations of private-school competition on public-school outcomes; explain the particular methodology and model used in the study; discuss the data; analyze the results; and discuss the implications of the findings as well as the limitation of the study for the larger body of research. (Contains 121 references.) (WFA)

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Does Private School Competition Affect Public School Achievement? An Analysis of North Carolina Data

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I. Introduction

The recent U.S. Supreme Court ruling in Zelman v. Simmons-Harris (2002) has once again placed school choice at the center of America's policy agenda. As a result of the ruling, vouchers and private schools have become the focus of research, and are viewed as possible instruments to help improve the quality of American education. Private schools are again being evaluated not only for any differential value they may add to the production of a student's education, but also for the effect increased levels of competition exercises on the educational environment and attainment of students generally.

The purpose of this study is to determine if there are any appreciable effects from private school competition on public school student achievement in North Carolina. The study utilizes a specific methodology popularized by Hoxby (1994[a]), and seeks to discover if the private school competition effects found by Couch, Shughart and Williams (1993) and Newmark (1995), can be duplicated when analyzing another cross-section of data (the 1998-1999 academic year) and incorporating the new methodology. The new methodological approach allows for a novel way to control for the simultaneity that exists between private school enrollment and public school outcomes. In keeping with the spirit of the Couch et al study no student sorting and selection choice model will be employed.

This study extends Couch et al's research in several other areas. First, multiple student outcomes are examined, including elementary as well as secondary student achievement results, and student dropout rates. Second, high school student achievement results are analyzed by ethnicity. Finally, the data is aggregated at three levels (district, county and "unified" county) to account for educational market particulars and competition between school districts in those areas where additional public school choice is available. While finding some evidence of trends found in previous research, there is no indication of significant private school competition effects for North Carolina public school outcomes in this data set.

The study is composed of nine sections: Section II provides a brief review of the private school competition empirical research; Section III discusses the unique public goods nature of education, the role of competition and provides two possible mechanisms through which private school competition may influence public school behavior; Section IV highlights the basic empirical issues involved in empirical estimation of private school competition on public school outcomes; Section V reviews the Couch et al study while Section VI explains the particular methodology and model to be employed in this study; Section VII discusses the data to be evaluated; and Section VIII analyzes the studies results. The final section (Section IX) discusses the implications of the findings as well as the limitations of this study for the larger body of research.

II. Review of the Private School Competition Literature

The current research agenda for the private school education literature was largely set with the series of studies James S. Coleman and his fellow researchers authored in the 1980's.[1] Using the *High School and Beyond* longitudinal study data, Coleman et al found that both Catholic and non-Catholic private schools are more effective than public schools in assisting students in cognitive skills acquisition. The Coleman series of studies furthered the analysis by incorporating a student selection model to account for the type of school students choose to attend (see Section IV below for a discussion of sorting and selection).

The Coleman studies ignited a series of responses and re-analyses of the *High School and Beyond* data.[2] Most notable among these studies was Noell's (1982), which found that after including additional explanatory variables,[3] private school students failed to produce significant gains in cognitive ability acquisition for seniors as measured in reading and mathematics performance (Noell 1982, pp. 131-132). Noell's contention was that the Coleman studies mistakenly overstated the impact of private schools by neglecting to

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[1] See: Coleman 1982; Coleman and Hoffer 1983 & 1987; Coleman, Hoffer and Kilgore 1981, 1982[a], 1982[b] & 1982[c]; and Hoffer, Greeley and Coleman 1985.

[2] See: Alexander and Pallas 1982, 1983 & 1985; Cain and Goldberger 1983; Jencks 1985; Murnane 1984; Murnane et al 1985; Noell 1982 & 1983; Willms 1985; and Witte 1992.

[3] Additional predictors included: sex, handicap status, region of residence, and eighth grade college attendance expectations (Noell 1982, pp. 125-127).

account for the additional explanatory variables, factors that would determine a student's self-selection into Catholic and other private schools and thereby account for the increase in student performance (Noell 1982, p. 125).

Murnane et al (1985) demonstrated a critical point in the literature as a result of the Coleman and Noell investigations: accounting for student selection is critical and can dramatically affect findings. Murnane et al showed that the difference in findings between Coleman and Noell lies in the researchers use of different models to account for selection (Murnane et al 1985, p. 26).

Towards the late 1980's the literature began to subtly change emphasis, and began to focus on the institutional structure of public and private schools. Chubb and Moe (1988 & 1990) argued that private schools possess characteristics that allow for greater organizational and administrative flexibility due in large part to their political and bureaucratic autonomy, allowing private school students to out perform their public school counterparts. The Chubb and Moe studies expanded the Coleman investigations, utilizing the *High School and Beyond* data, and have reintroduced public finance and public goods issues into the private school discussion, as a well as maintaining that competition in education markets has beneficial effects for students generally by promoting greater student productivity (increased student achievement) and greater resource efficiency (greater student productivity for dollar spent).

Another shift in emphasis arose in the early 1990's when some researchers began to utilize more simplistic models and specifications to estimate the effect of private school competition. These studies, while acknowledging the Coleman literature, began to depart from many of the specific theoretical and methodological discussions at issue in that literature. Specifically, many of these studies did not incorporate any formal student selection model, the most significant issue governing the Coleman literature, and instead focused their attention on another issue: modeling the simultaneous nature of private school enrollment with public school quality (ex: Borland and Howsen 1992; Couch,

Shughart and Williams 1993; Dee 1998; Hoxby 1994[a]; Newmark 1995; Simon and Lovrich 1996; and Sander 1999).

Again, the empirical results demonstrated a mixed pattern with several studies finding positive effects from private school competition (Borland and Howsen 1992; Couch, Shughart and Williams 1993; Dee 1998; Hoxby 1994[a]), while several found no significant effects, mixed effects, or even negative impacts from competition (Newmark 1995; Simon and Lovrich 1996; and Sander 1999).

Ironically, the most recent studies, beginning in the mid 1990's and running through the present, have returned to the issues and agenda outlined by the Coleman literature in a more direct fashion. These studies emphasize both a concentration on issues of student selection as well as accounting for issues of simultaneity, and have developed some particularly elaborate models (ex: Figlio and Stone 1999; and Goldhaber 1996). Again, the findings have been mixed, especially with regards to the effect private school competition exercises on public school student test scores.[4]

However, this most recent set of studies has expanded the analysis by examining several other measures of student performance including: high school graduation/dropout rates, the probability of college entrance, average wage rates, etc. Studies using these public school student outcomes have found a more consistent patterns of positive impacts on student performance resulting from private school competition, especially with regards to reducing public high school dropout rates and increasing the probability of public school students attending college (ex: Altonji, Elder and Taber 2000; Evans and Schwab 1995; Neal 1997 & 2000; Sander 1996 & 1997; and Sander and Krautman 1995).

III. Competition as a Mechanism for Improving Student Performance

One aspect that marks the private school competition research, and the school choice literature generally, is the contention that education is a unique good, and therefore does not respond to the incentive structure generated by a market environment (see Stiglitz

[4] See Hoxby (1998) and Neal (1998) for literature overviews for this later period.

2000[a], pp. 434-435 for an overview of the arguments). This section provides a brief sketch of two of the most important elements of these arguments, the public goods status of education and the role of competition, while providing two possible mechanisms private school competition may operate through to impact public school behavior.

Education as a Public Good

Education is generally considered to be an "impure" or "mixed" public good[5]: education can be produced like other private goods without generating externalities, or spillover effects, although the *consumption* of education by individuals generates externalities that accrue not only to the individual but to society at large (Buchanan 1968; Stiglitz 1974 & 2000[a]).

Examples of such externalities in consumption include increases in social capital (ex: a better educated populace; adherence to a common set of values and norms; and socialization of diverse ethnic populations generally), increases in human capital (ex: direct benefits to families and individuals that invest and consume education in terms increased expected future income, and increased productivity, technology and economic growth generally), and may also have negative impacts on social and human capital (ex: increase ethnic stratification; parents making sub-optimal investments in education for their children because of lack of resources, knowledge or interest; or other distributional inequities).

These consumption externalities, particularly the distributional concerns, are the primary reason for public provision of education (on these points see: Becker 1993; Buchanan 1968; Dee 2003; Friedman 1955; Gradstein and Justman 2000; Hanushek 2002; Lott 1990 & 1999; Machlup 1970; Stiglitz 2000; and West 1965).[6]

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[5] A "pure public good" is defined as possessing two characteristics: (1) the marginal cost of an additional person consuming it is zero; and (2) the cost of excluding an individual is infinite (prohibitive), the non-exclusivity principle (Buchanan 1968, p. 36; and Stiglitz 1974, p. 350).

[6] Gradstein and Justman (2000) argue that these arguments do not necessarily imply public provision as much as they imply public financing, and leave open the question of provision and institutional structure.

Competition as a Discovery Procedure

In light of the preceding discussion, that education is indeed a unique good, specifically an impure public good, requiring at minimum public financing if not complete public provision to overcome the externalities generated in consumption, how then can markets and competition improve educational outcomes? The answer lies in an understanding of the competitive *process*.

Hayek (1945) has argued that the fundamental problem of economics is not just one of distributional concerns in terms of resource allocation, but "is a problem of the utilization of knowledge which is not given to anyone in its totality" (Hayek 1945, p. 78), and that "it is only through the process of competition that the facts will be discovered" (Hayek 1946, p. 96).

Further, Hayek maintained that the market, like language and law, is an example of a spontaneous order, the result of human interactions and not of any conscious human design. The price system is really nothing more than a communication system: "The most significant fact about this [price] system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action" (Hayek 1945, p. 86). Certain aspects of modern neoclassical competitive analysis have incorporated elements of Hayek's argument, in particular the idea of prices as "aggregators of information" (Grossman and Stiglitz 1976, p. 252).[7]

Competition is essentially a discovery procedure, Hayek contends, that allows individuals with, in many instances, tacitly held knowledge to achieve and realize those ends they seek without being aware of other's plans or knowledge. In particular, the market and the price system help coordinate activity without serving a "given hierarchy of ends" (Hayek 1968, p. 183). With regards to Hayek's arguments concerning the price system as a

[7] Grossman and Stiglitz (1976) and Stiglitz (2000[b]) contend that Hayek's explanation of competition, while addressing resource scarcity, fails to account for market failures that lead to sub-optimal (in terms of realizing Pareto optimal market outcomes) investments in information by market participants, issues that result in moral hazard and principal-agent problems. For a critique of the economics of information's appropriation of Hayek's ideas, especially Grossman and Stiglitz's synthesis, see Thomsen (1992). For an overview of the theories of competition see Vickers (1995).

communication system, the greater the degree of competition the greater opportunity for informational asymmetries to be solved.

To the extent that public education encounters principal-agent dilemmas due to asymmetries in information, competition viewed in this context may improve the market outcomes, by providing more information to consumers (parents and students) about the quality of goods (schools and student achievement) in the market. Additionally, greater competition should generate financial incentives for schools to be more resource efficient, producing better results (presumably increased student achievement) with fewer resources (dollars and/or students).

Two Possible Mechanisms Competition May Influence Public School Behavior

The theoretical mechanism by which private schools may exercise some degree of influence over public school behavior are of two types: (a) where school administrators respond to competitive pressures from private schools in the form of financial incentives (losing students to private institutions and therefore losing student funds) by adjusting their behavior (retaining only "effective," well educated teachers, minimizing costs, increasing student achievement, etc.); or (b), through student sorting/selection between institutions along any of several lines (academic, behavioral, socioeconomic, etc.).

Hoxby notes that private school competition makes total public school budgets depend positively on public school productivity (better student performance by public schools, yields increased student enrollment in public schools, and therefore more total funds). However, it is not clear what effect competition will have on public school *per-pupil* budgets. Public per-pupil budgets may actually *increase* when private school competition draws more students away from the pool of public school students, especially if total school budgets remain constant (approximately the same amount of funds allocated over fewer students). With no fixed costs of providing public schooling, school personnel would most likely prefer higher per-pupil budgets regardless of the total school budget (Hoxby 1994[a], p. 6).

To the extent that fixed costs due play a role, the utility of public school personnel may fall with the total school budget, irrespective of per-pupil budgets. Therefore, greater private school competition will improve the financial incentives faced by public schools if per-pupil as well as total public school budgets depend positively on public school productivity (better student performance) or if public school personnel are more sensitive to total public school budgets. Greater private school competition will worsen financial incentives facing public schools if public school personnel are sensitive primarily to per-pupil budgets and per-pupil budgets depend negatively on public school productivity (Hoxby 1994[a], pp. 6-7). State educational agencies (SEAs) and local educational agencies (LEAs) can undermine these financial incentives to the degree that they subsidize local school's total and per-pupil budgets when they lose students (Arum 1996 and Hoxby 2001).

IV. Empirical Issues

The private school competition literature is confounded by two central empirical issues when attempting to estimate competition's impact on public school student outcomes: endogeneity and student sorting and selection. First, public school quality is simultaneously determined with private school enrollment: the endogeneity issue. Second, the effect of student sorting and selection may be driving the results, which may be independent of public school quality. Each of these issues is discussed in turn.

Endogeneity

First, endogeneity: demand for private schools is certainly correlated with the quality of public schools. This is a consequence of the demand for private school education being jointly determined by the quality of local public schools. This issue is known as simultaneity, and can be seen from examination of a simple regression equation.

Suppose we wished to estimate equation (a) below. Using ordinary least squares (OLS) we can regress some metric of student achievement, say standardized test scores, onto private school enrollment, measures of school demographics (teacher experience, education, class size, per pupil expenditures, etc.), student characteristics (race, gender,

student ability, etc.), family demographics (family income, parent education, race, etc.), and an error term (ϵ). We are interested in the estimated coefficient β_2, the coefficient on the private school enrollment variable. However, private school enrollment is certainly correlated with the standardized test scores: poor public school quality (low test scores) may determine private school enrollment, or private school student enrollment may be determining public school test scores by changing student populations (e.g. all of the high performing students may enroll in private schools; the so called "cream skimming" scenario).[8]

$$\text{STUDENT ACHIEVEMENT} = \beta_1 + \beta_2 \text{ PRIVATE} + \beta_3 \text{ SCHOOL DEMOGRAPHICS} + \beta_4 \text{ STUDENT CHARACTERISTICS} + \beta_5 \text{ FAMILY DEMOGRAPHICS} + \epsilon \quad \text{(a)}$$

Standard OLS assumes that the explanatory variables are independent and exogenous relative to the dependent variable and the error term. Although, in this case private school enrollment is jointly determined with test scores: this is simultaneity. If this simultaneity is not accounted for by using statistical techniques to insulate the explanatory variables, the resulting OLS coefficient estimate on private school enrollment (β_2) will be biased (downwards), understating the effect of competition on public school student achievement.

In order to obtain unbiased estimates of the private school competition effect (β_2), a private school participation equation can be specified. Equation (b) specifies the determinates of private school enrollment:

$$\text{PRIVATE SCHOOL ENROLLMENT} = \alpha_1 + \alpha_2 \text{ CATHOLIC MEMBERSHIP} + \alpha_3 \text{ SCHOOL DEMOGRAPHICS} + \alpha_4 \text{ STUDENT CHARACTERISTICS} + \alpha_5 \text{ FAMILY DEMOGRAPHICS} + \upsilon \quad \text{(b)}$$

[8] There are several theoretical accounts establishing that increased stratification and "cream skimming" will result when consumers are faced with increased school choice, especially vouchers (see Epple and Romano 1998 and Stiglitz 1974). However, the empirical literature has shown inconsistent and contradictory results, yielding support for both positive and negative student sorting and selection (Arum 1996; Epple and Romano 2002; Evans and Schwab 1995; Figlio and Ludwig 2000; Figlio and Stone 1999; Goldhaber 1996; Hanushek 2002; Hoxby 2001; Ladd and Fiske 2000; Ladd and Fiske 2001; Neal 1997; and Witte 1992).

What is required is an instrument that accounts for private school enrollment, but is unrelated to the unobserved determinants (the error term in equation (a), ϵ) of public school quality. This instrument can then yield unbiased estimates of β_2. Once a reliable instrument is found for private school competition, like Catholic membership, then alternative estimations techniques can be utilized. Techniques such as instrumental variables (IV) which allow the researcher to estimate a two-equation system, like equations (a) and (b) above, while controlling for the simultaneity between private school enrollment and public school test scores, yielding unbiased estimates of β_2.

Student Sorting and Selection

A second effect, associated with issues of simultaneity, is student sorting and selection. Some authors consider this issue to be the most important and most difficult issue to surmount when trying to empirically estimate differences between public and private schools (see: Evans and Schwab 1995, p. 961; and Hanushek 2002, p. 72).

Student sorting is the result of decisions parents and students make regarding the type of school they attend. Technically, sorting is one aspect of selection (self selection): sorting is the economic description of an individual's decisions to attend certain institutions, and not others. At least four types of sorting can be identified: (a) along ability lines (most or least able children tend to enroll in private schools); (b) along personality lines (most disruptive students tend to enroll in private schools or vice versa); (c), along taste lines (parents may choose private schools for non-traditional curricula, for moral/religious preferences, etc.); or (d) along socioeconomic lines (sorting may lead to economic/racial stratification) (see Hoxby 1994[a], pp. 7-8).

Sorting may influence public school outcomes directly through changes in parent and student populations, or may affect them indirectly via peer effects and teacher heuristics tailored to their student's needs. Sorting may increase the variation of student outcomes by transforming peer effects (reducing interactions between more able students on less able students and vice versa), or it may decrease variation in student outcomes when

teacher techniques become tailored to each student (thereby equalizing outcomes across abilities)(Hoxby 1994[a], p. 31). For instance, in a recent study examining student-level data from both public and private schools across five countries (Belgium, France, New Zealand, Ontario, and the United States), researchers found that raising the average peer level increases individual student achievement across all school types and countries, particularly for lower-performing students (Zimmer and Toma 2000, pp. 88-89).[9]

Selection is closely related to student sorting, in that selection is concerned with the effects of student populations on outcomes. Formally, selection bias occurs when a model is estimated, as equation (a) above, over a non-random sub-sample of the larger population, with researchers then seeking to determine behavioral relationships for the larger population (see: Heckman 1979; and Kennedy 1998, pp. 251-252). Two processes may generate such results: (i) self selection (sorting, discussed above) by the individuals under investigation; or (ii), decisions by the researcher in composing the sample (Heckman 1979, p. 153).

For instance, suppose we estimate equation (a) only using test scores for high performing (or only low performing) public school students, and then wish to make generalized inferences about the total public school student population. Clearly, high performing (low

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[9] Peer group effects and their impact on student achievement is an unsettled question in the literature. Oakes (1985) now classic statement that ability tracking (grouping classrooms homogeneously by ability level) of students perpetuates achievement inequities between ethnic and socioeconomic groups is the standard position (see also Oakes 1990 & 1992). Empirical estimation of peer group effects are confounded by omission of relevant variables, the endogenous nature of school choice, and the ability of schools to "informally" track students (see: Betts and Shkolnik 2000[b]; Evans, Oates and Schwab 1992; Figlio 2002; Hanushek et al 2000; Rees et al 2000; and Rivkin 2001). Argys et al (1996) find that abolition of public school tracking would yield large and positive impacts on achievement for students in lower tracks, at the expense of public school students in the upper-tracks. Hoxby (2000[a]) find positive impacts from heterogeneous peer effects, but also finds evidence that peer effects are stronger intra-race, and that some effects do not work through achievement. For instance, Hoxby finds that females in the classroom has a positive effect on male math scores "that could not come through females' effect on mean peer achievement in math" (Hoxby 2000[a], p. 36). Zimmer (2003) finds that tracking reduces positive peer effects on low- to average-ability students, while having no measurable effect on high-ability students. In contrast, Epple and Romano (1998), Epple et al (2002) and Caucutt (2002), while finding slight evidence of achievement gains/losses from peer effects and tracking, argue the largest impact of tracking is its re-distributional effect from lower- to higher-ability students in public schools, especially in the presence of school choice and voucher programs. After controlling for endogeneity, Figlio (2002) finds that public school tracking does improve student performance for lower-achieving students when you compare not just tracked and non-tracked students, but compare students of similar achievement levels within the same school (Figlio 2002, p. 513).

performing) public school students are not representative of the entire student population. The estimated coefficients would be biased, overstating (understating) the effect of private school competition. In this sense selection can be viewed as determining the sample of student outcomes (e.g. standardized test scores) we observe as dependent variables.

Generally, selection bias is assumed to overstate the private school competition effect. As with sorting, the direction of the bias is unclear since multiple effects can work in opposing directions. In contrast to issues of positive selection (e.g. "cream skimming," overstating the estimated effect of private school competition), is the contention that certain private schools (generally Catholic/religious schools) experience *negative* selection. In the case of negative selection private schools may become repositories for behavioral and/or ability challenged students (see: Evans and Schwab 1995, p. 970; Figlio & Ludwig 2000, pp. 24-25; and Neal 1997, p. 115 note # 20).[10] The estimated coefficient (β_2) will understate the competition effect in this case. Considerations such as these render ex ante predictions of the effect of student sorting and selection inconclusive (Murnane et al 1985, p. 24).

Most studies attempt to address these issues empirically by estimating a two equation, reduced form model, where the equation of interest is some education production function, and the secondary equation is some demand for private school enrollment/education. To solve the endogeneity issue several studies have employed an instrumental variables approach, and use Catholic concentration/population to instrument for private school student enrollment, since Catholics are highly correlated with private school provision (approximately 65 percent of U.S. private school students attend a school affiliated with the Catholic Church; Hoxby 1998, p. 50) but uncorrelated with demand for private school education that is the result of poor public school quality (Dee 1998; Evans and Schwab 1995; Hoxby 1994[a]; Neal 1997, 1998 and 2000; Sander 1999).

[10] Student selection and the direction of the bias is hotly contested within the literature. Some researchers find little evidence of positive selection (Hoxby 1994[a], 1998 and 2001; Neal 1997 and Sander 1996), while others maintain that there is strong evidence, particularly in systems that have extensive choice programs (see Ladd and Fiske 2000 & 2001 for evidence from New Zealand).

Still other researchers have used instruments such as market concentration ratios (Herfindahl indexes), borrowing from the industrial organization literature in economics, to address issues of simultaneity and have arrived at very similar results: increased standardized test scores for public school students when market concentration falls; increased wage rates for public school teachers in less monopsonistic labor markets; etc. (see Borland and Howsen 1992, 1993 and 2000).

More recently, some researchers have argued that Catholic membership is a poor instrument because it fails many simple tests of exogeneity. These researchers contend that religious affiliation should be included as an explanatory variable in both the school outcomes (a) and private school participation (b) equations (Altonji et al 2002; Figlio and Stone 1999; and Kane 1996). These issues will be addressed in the discussion of the results below (Section VIII). This current study is an attempt to replicate those studies using Catholic membership as an instrument using North Carolina data.

V. Review of the Couch, Shughart and Williams Study

The original Couch et al paper has generated a considerable body of literature in its own right. While the results are similar to other studies that find beneficial effects from private school competition on public school student achievement, the econometric issues raised by this study have been extremely contentious. This study provides an excellent template from which to illustrate the pitfalls this literature is fraught with. Further, the Couch et al study will act as a "benchmark" for the current analysis: once issues of simultaneity have been accounted for, can we still find significant private school competition effects in another cross section of North Carolina data?

The Couch et al literature demonstrates two important elements. First, simultaneity must be accounted for in an attempt to estimate private school competition effects on public school student achievement. Second, when modeling private school competition, the need to control for student sorting and selection is of paramount concern.

Couch, Shughart and Williams

Couch et al analyze North Carolina data for the 1988-1989 academic year with end-of-course (EOC) Algebra I exam scores as their metric of public school student achievement. The authors control for race, the education level of the parent's, poverty rate, county population density, and total per pupil expenditures. They find that the estimated coefficient on private school enrollment exhibits a significant effect on public school test scores: test scores increased by 0.08 (t-statistic = 2.23) standard deviation points above the statewide mean (Couch et al 1993, p. 308).

Couch et al address both the simultaneity and selection issues, but fail to control for either. First, the authors attempt to address student sorting and selection by declaring that the direction of causality in equation (ii, see note # 11 below) runs only from private school enrollment to public school test scores. Couch et al assume that it would not be the case that low performing public school students would "seek less stringent educational standards" in private schools (Couch et al 1993, p. 306). The implication is that all private schools have higher academic standards than public schools, which is not the case, and that any finding of significant positive estimated competition effects on public school test performance are not due to lower performing public school students leaving public schools.

The second stipulation asserts that the two equations,[11] one for private school participation and one for public school outcomes, are recursive. Recursive systems require the endogenous variables to be unidirectional in their dependency. The authors are claiming that private school enrollment determines public school test scores, with no

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[11] Couch et al's two equation model is represented by a private school participation equation (Couch et al 1993, pp. 304-305 & 307):

$$\text{PRIVATE ENROLLMENT} = \alpha_1 + \alpha_2 \text{ PERCENT BLACK} + \alpha_3 \text{ PERCENT COLLEGE EDUCATED} + \alpha_4 \text{ TOTAL FUNDING PER STUDENT} + \alpha_5 \text{ PERCENT BELOW POVERTY} + \alpha_6 \text{ PER CAPITA INCOME}_{1987} + \alpha_7 \text{ POPULATION DENSITY} + e \quad \text{(i)}$$

And the public school student outcome equation is represented by:

$$\text{ALGEBRA1 SCORE} = \beta_1 + \beta_2 \text{ PERCENT BLACK} + \beta_3 \text{ PERCENT PRIVATE SCHOOL STUDENT} + \beta_4 \text{ TOTAL FUNDING PER STUDENT} + \beta_5 \text{ PERCENT BELOW POVERTY} + \beta_6 \text{ PERCENT PARENTS w/LESS THAN HIGH SCHOOL EDUCATION} + \beta_7 \text{ POPULATION DENSITY} + u \quad \text{(ii)}$$

possibility that the opposite may be true. Couch et al have simply assumed the simultaneity issue away. As was discussed above in Section IV, it is precisely this simultaneous nature between private school enrollment and public school outcomes that confounds empirical estimates (see Borland and Howsen 1996).

VI. Methodology and Model

The current study utilizes a two-equation reduced-form model, incorporating an instrumental variables (IV) approach similar to that employed by Hoxby (1994[a]). The model is:

$$\text{STUDENT ACHIEVEMENT}_{ij} = \beta_1 \mathbf{X}_{ij} + \beta_2 \mathbf{S}_{ij} + \beta_3 \boldsymbol{\rho}_{ij} + \beta_4 P_{ij} + \epsilon_i \qquad (1)$$

Where public school student achievement is measured by standardized test scores or student dropout rates, **X** is a vector of county level demographics (race, per capita income, unemployment rates, population density, labor participation rate, etc.), **S** is a vector of school district/county level characteristics (teacher experience, teacher education, per pupil expenditures, etc.), $\boldsymbol{\rho}$ is a vector of student peer characteristics (which only includes race), P represents the private school competition effect (county level private school enrollment), and ϵ is an error term for the i^{th} county and the j^{th} school district.

As discussed previously, when trying to estimate the possible impact from private school competition on public school outcomes, determination of causality is confounded by simultaneity: private school enrollment is endogenously determined with public school quality. In order to avoid such confounding effects I will estimate a reduced form demand for private school education model represented by:

$$\text{PRIVATE SCHOOL ENROLLMENT}_i = \beta_1 \mathbf{X}_{ij} + \beta_2 R_i + \beta_3 \mathbf{S}_{ij} + \upsilon_i \qquad (2)$$

Where **X** again is a vector of county level demographics as in (1), R is religious affiliation by county i, **S** is a vector of school district/county level characteristics (teacher

experience, teacher education, county population density, etc.) as in (1), and υ is an error term. The estimated coefficient on the private school competition (β_4 in equation (1)) in ordinary least squares (OLS) would be biased downwards, thereby understating the competitive effect if public schools are producing lower quality student achievement. Alternatively, if sorting and selection effects dominate then OLS estimates not accounting for such endogeneity may bias the estimates upward, and overstate any effect of private school enrollment on public school outcomes. I use county Catholic membership as an instrument for private school enrollment.

VII. Data

The bulk of the data comes from two main sources: North Carolina Department of Public Instruction (NCDPI) and the 2000 U.S. Census, with the data set representing a single cross-section for the academic year 1998-1999. Three sets of student outcomes are used in the analysis: North Carolina public high school end-of-course (EOC) exams, elementary level end-of-grade (EOG) exams (grades 3-8), elementary level writing exams (grades 4 & 7), and high school dropout rates. Each is discussed in turn (see Tables I and the Data Appendix for full variable descriptions).

Before discussing the student outcomes, there are two general notes regarding the data. First, the small proportion of Catholics in North Carolina (Wake County (Raleigh, NC) which has the largest Catholic concentration in the state, only reports a Catholic population of 10.4 percent) may reduce the effectiveness of Catholic membership as an instrument. Indeed, 10 counties register no official Catholic membership whatsoever.[12] However, Sander (1999), using a model similar to the one employed in this study, found no effect from private school competition on public school outcomes, even when examining data from one of the largest Catholic school systems in the United States (Chicago, IL)(Sander 1999, p. 706).

[12] Eight counties have no church/parish within their borders (Bertie, Camden, Caswell, Gates, Greene, Jones, Northampton, and Perquimans), while Currituck County has two chapel missions with no membership figures available, and Hyde County falls under the authority of the Outer Banks Catholic Parish, again with no figures available.

Second, North Carolina not only has 100 unified county-level school districts, but an additional 17 independent city school districts as well.[13] To account for the variation in school district allocation throughout the state, the analysis has been decomposed into three subsets: (i) analysis using all 117 North Carolina school districts; (ii) analysis conducted at the county level, using only the 100 county districts with the city unit districts collapsed; and (iii), analysis examining only the 88 "unified" counties, counties that had no independent city school district within them. All variables have been adjusted (using weighted means) whenever the sub-samples were either collapsed or expanded.

Hoxby notes that defining a "local education market" for estimation purposes is critical for two reasons. First, if one defines the education market too narrowly (at the district level) the estimates run the risk of being biased. In this instance, parents who care more about education, and have the resources to act on these commitments, are likely to move across market boundaries (in this case, school districts) to get better schooling for their children, so estimates may be biased since parents in markets with better schools systematically care more (or have the resources to affect change) about education (Hoxby 1994[a], p. 3 note # 4).

Second, defining the local education market too broadly will miss critical masses of religious denominations, which help make Catholic and other religious private schools a competitive alternative to public schools (through volunteering in the school, providing funds to subsidize tuitions through endowments, offerings, etc.). In this case Hoxby views state level aggregation as too broad and will miss out on the concentrations of Catholics throughout a state. She concludes that the county is probably the most "ideal" local education market (Hoxby 1994[a], p. 3 note # 4).

Considerations such as these suggest the appropriate level of analysis would involve multiple levels of aggregation of the data. This will allow the study to overcome several

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[13] The counties with their associated city districts are: Buncombe (Asheville City); Cabarrus (Kannapolis City); Catawba (Hickory and Newton-Conover Cities); Cleveland (Kings Mountain and Shelby Cities); Columbus (Whiteville City); Davidson (Lexington and Thomasville Cities); Halifax (Roanoke Rapids and Weldon Cities); Iredel (Mooresville City); Orange (Chapel Hill-Carrboro Cities); Randolph (Asheboro City); Sampson (Clinton City); and Surry (Elkin and Mount Airy Cities).

of the issues raised by Hoxby as well as capture some of the unique features of the North Carolina educational landscape.

End-of-Course Exams

The first student outcome examined is the end-of-course (EOC) public high school exams (also administered at charter schools, however, all charter school exam data has been excluded). The EOC was developed in response to legislation passed by the North Carolina General Assembly – the North Carolina Elementary and Secondary Reform Act of 1984 (NCDPI 1999, p. 1). The EOC are multiple choice exams, administered in the ninth through twelfth grades, and are offered in 10 subject areas.[14] For the 1998-1999 academic year, approximately 631,481 students exams were administered,[15] from a total public school student population of 344,730 (ninth through twelfth grades, including both public and charter students).[16]

The EOC utilize a series of score types to allow for a variety of comparisons between students and academic years: scale scores, percentiles, and achievement levels. The scores reported here are achievement levels, which measure the percent of students taking the exam at or above Level III. The Achievement Levels are standards established by North Carolina teachers, approved by the state legislature, and are assessments of how well students are expected to perform on the exams. There are four levels reported for each exam (Level I to Level IV). Level III is defined by the NCDPI to be those students who "demonstrate mastery of the course subject matter and skills and are well prepared for more advanced level in the content area" (NCDPI 1999[a], p. 2; and *Greenbook*). Across all EOC multiple-choice exams, approximately 52 percent of the state public school population performs at Levels III and IV (NCDPI 1999[a], p. 2).

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[14] The subjects are with their original norming year: Algebra I (1987); Algebra II (1988); biology (1987); chemistry (1989); Economic, Legal, and Political Systems (ELPS) (1991); English I (1990); geometry (1989); physical science (1991); physics (1990); and U.S. history (1988). For the 1998-1999 academic year, English II was the only exam not mandated by the state. English II is an on-demand writing assessment exam, and is evaluated independently.

[15] For the academic year of 1998-1999, the number of students taking EOC subject exams were: Algebra I (87,404); Algebra II (48,956); biology (76,872); chemistry (41,261); ELPS (77,740); English I (89,679); geometry (60,764); physical science (67,397); physics (11,221); and U.S. history (70,187) (NCDPI 1999[a]).

[16] See the 1998-1999 North Carolina State Testing Results (*Greenbook*): http://www.ncpublicschools.org/accountability/testing/reports/green/index.html#99GreenBook, and http://www.ncpublicschools.org/fbs/stats/pdf/2000p1.pdf

One limitation of using EOC exams as indicators of student achievement is that EOC exams are not mandatory for all students in all subject areas, introducing sorting and selection by both students and schools. While the No Child Left Behind (NCLB) legislation seeks to remedy this in current practice, opportunity for such student sorting was available during the 1998-1999 school year. Fortunately, the NCDPI required four subjects for all students seeking to graduate from North Carolina high schools in 1998-1999: Algebra I; Biology; Economic, Legal, and Political Systems (ELPS); and U.S. History (NCDPI 1998). These requirements were effective through the 1999-2000 school year.[17]

End-of-Grade Exams

Analysis of elementary (grades 3-8) end-of-grade (EOG) exams provide an assessment that minimizes student sorting issues (EOG exams are mandatory for all students) and provides a check to whether private school competition effects may be age specific, as suggested by some researchers (Hoxby 1994 and Sander 1999). For instance, the majority of private schools in North Carolina are concentrated at the elementary level. North Carolina private school enrollment totaled 84,384 for grades K-12 in 1998-1999 (excluding charter and home school enrollment). Grades K-8 account for 79.4 percent of all private school students (66,989 students), while private high school student enrollment comprises only 20.6 percent of the total (17,395 students).[18]

In comparison, total public school enrollment (grades K-12, inclusive of charter schools) was 1,295,780, with K-8 grades accounting for 73.4 percent (951,050 students), while ninth through twelfth grades accounted for 26.6 percent (344,730 students) of the public school total enrollment for 1998-1999.[19] Assuming a uniform distribution of students

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[17] The formal NCDPI graduation requirements for 1998-1999 included 20 units: English (4 units); mathematics (3 units), one of which must be Algebra I; social studies (3 units), one of which must be government and economics (ELPS), one in U.S. History, and one in world studies; science (3 units) one of which must be biology, one physical science, and one in environmental science; heath and physical education (1 unit); and other courses which may be "designated by the LEA, which may be undesignated electives or courses designated from the *NC Standard Course of Study*" (NCDPI 1998).

[18] See: http://www.doa.state.nc.us/dnpe/hhh548.htm

[19] See: http://www.ncpublicschools.org/fbs/stats/pdf/2000p1.pdf

throughout the thirteen grade levels, one would expect to find approximately 69.2 percent of the students in grades K-8, and 30.8 percent in grades ninth through twelfth. Clearly, private schools have above and below average enrollments for the two groups respectively.

The concentration of private school students in the elementary grades is even more pronounced when considering only grades K-6. In this instance, private school enrollment accounts for 64.9 percent (54,766 students), while public and charter schools account for 58.0 percent (751,356 students) of total enrollment. This indicates that any possible private school competition effects, whether positive or negative, would more likely be evidenced in the elementary data and in EOG scores.

EOG exams are mandated by NCDPI for grades three through eight in two main areas, reading and mathematics, while writing is tested in the fourth and seventh grades. These exams are required of all students in their respective grades. All three content areas of the EOG – reading, math and writing – are used in the analysis. The scores reported here are the percent of students taking the exam within the county that scored at or above Achievement Level III, just as with the EOC exams (again, charter school students are excluded).

Dropout Rates

While the original Couch et al studies concentrated exclusively on standardized test scores, this study seeks to expand the analysis by examining student outcomes beyond standardized test scores, and including public high school dropout rates. In fact, the school choice literature has re-ignited the debate regarding the most appropriate and efficacious measure of school quality and student achievement. Several researchers argue that standardized test scores are a poor barometer of both student achievement and future labor market success (Card and Kruger 1992; Card and Krueger 1996; Evans and Schwab

1995; Hanushek 2002; and Krueger 1999).[20] This theme is both reinforced and echoed by several of the recent discussions evaluating the high-stakes accountability systems employed by many states (Figlio and Getzler 2002; Hanushek and Raymond 2001; and Ladd 2001).

Several recent studies have found consistent private school competition effects in other public school student outcomes, despite not finding simultaneous competition effects in standardized test scores. Examples of alternative student outcomes where private school competition exercised an appreciable effect include: public high school graduation/dropout rates, probability of going on to college, average wage rates, etc. (Altonji et al 2000; Dee 1996; Evans and Schwab 1995; Figlio and Stone 1999; Hoxby 1994[a]; Mocan et al 2002; Neal 1997, 1998 and 2000; Sander and Krautman 1995). This makes evaluation of public school dropout rates an excellent candidate for analysis.

In the 1998-1999 academic year NCDPI adjusted the ABCs program, the State's accountability program, by redefining the State's dropout policy. The new policy includes students who transfer from high school to community college, students whom were previously omitted from the dropout calculus prior to 1998-1999 (NCDPI 2000).[21]

VII. Results

The goal and purpose of this study is to determine if any appreciable private school competition effects can be evidenced in North Carolina public school data while adapting Hoxby's methodological approach. An extension of this central focus is to use Couch et al's study as a template to further determine if their findings can be duplicated with a

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[20] In contrast, Betts (1995) rejects the Card and Krueger hypothesis that worker earnings are independent of which high school they attended, Murnane et al (1995) found that basic cognitive skills acquired by female and male high school seniors had a large impact on wages several years out of gradation.

[21] The formal ABCs definition of dropout rate: The numerator for the ABCs dropout rate is the total number of dropouts in grades 9-12 minus the total number of expulsions, long term suspensions, and students incarcerated in an adult facility. The ABCs dropout membership is the 20th-day 1998-1999 membership in grades 9-12, minus the initial enrollees in membership on day 20 in grades 9-12, plus the 20th-day 1999-2000 membership in grades 9-12, divide the result by two. The ABCs rate is calculated as the ABCs dropout numerator multiplied by 100, divided by the sum of the ABCs dropout rate membership plus the ABCs dropout numerator. A school had to have membership data for both years to be reported (NCDPI 2000).

unique data set, using slightly different model specifications, while controling for issues of simultaneity.

This section evaluates the results by dividing the findings into three subsections: (1) a discussion of the EOC exams; (2) a discussion of the EOG exams; and (3) a discussion of the dropout rate analysis. A final subsection discusses issues pertaining to instrument validity. While there is little evidence of any statistically significant impacts from private school competition in the data set, several patterns emerge that are both instructive and that are found in the larger literature.

EOC Exams: Analysis of the 117 Districts, 100 Counties and 88 "Unified" Districts

Public school student performance on EOC exams were evaluated in four aspects: (a) using the NCDPI generated composite test score (the district average across all 10 subject areas); (b) using the four required individual subject area test scores (Algebra I, Biology, ELPS, and U.S. History); (c) using an average of the four required subject areas; and (d), using a variety of supplementary sensitivity checks.

Regardless of sub-sample size or dependent variable evaluated (EOC exams composite score, the individual subject areas test score, or restricting the dependent variable to the average of the four required subjects test scores) private school enrollment failed to impact public school test scores (see Tables II-IV). One significant pattern is minority public school populations[22] exhibiting consistent downward pressure on the percentage of students scoring at or above grade level, a trend consistent with the larger literature's findings.

In Tables II through V the first stage Catholic membership estimates from the private school participation equation are provided. This is one ad hoc way to evaluate the adequacy of the instrument. Estimates should indicate a significant and positive relationship between Catholic membership and private school enrollment if the

[22] Minority = the percentage of African American, American Indian, Asian, and Hispanic public school students within the district.

hypothesized relationship is indeed correct. Notice that while the Catholic membership estimated coefficient (located at the bottom of each table) is "right-signed," that is, exhibiting a positive relationship to private school enrollment, it is uniformly insignificant.

Additional sensitivity tests provided several trends observed in previous studies with regards to public student ethnicity.[23] While specifications involving only white public school students had little effect, those specifications involving only African American students produced some interesting trends, albeit, insignificant ones. Irrespective of sub-sample size (117, 100 or 88 districts/counties) and regardless of the test score examined[24] African American students experienced significant reductions in the size of the standard errors (White/robust standard errors to account for the possible heteroskedasticity across school districts) for both the private school enrollment and Catholic membership coefficients. The results are not reproduced here since the estimates are insignificant at conventional levels. However, the pattern is worth noting since several researchers have found significant and beneficial private school effects for minority, particularly African American students, even in the absence of finding beneficial effects for the larger student population (Dee 1998; Evans and Schwab 1995; Neal 1997 and 1998).[25]

EOG Exams: Analysis of the 117 Districts, 100 Counties and 88 "Unified" Districts

The evaluation of EOG exams utilizes the entire battery of tests administered to public school elementary students: reading, grades 3 through 8; mathematics, grades 3 through 8; and writing exams administered at grades 4 and 7. Each content area is evaluated individually for each grade level. Unlike the EOC analysis, grade levels and content areas are not combined to transform the dependent variable. Additionally, EOG exams are not

[23] Additional specifications include: dependent variables group by subject area ("sciences" = biology and Algebra I; and "social sciences" = ELPS and U.S. History); substituting either charter or home school enrollment for private school enrollment (no change in other covariates); composition of a "competition" variable (private + charter school enrollment for 117 districts, otherwise private + charter + home school enrollment for 100 and 88 county specifications) in place of private school enrollment; and finally evaluation of student achievement by ethnicity (white or African American), discussed in text above.

[24] EOC exams used include: four required subjects averaged (Algebra I, Biology, ELPS, and U.S. History); average of the "sciences" (Algebra I and Biology); average of the "social" sciences (ELPS and U.S. History); and each of the four required subject areas individually.

[25] These trends and patterns for African American students are also exhibited in OLS specifications.

decomposed by ethnicity. One feature that enhances EOG analysis is the inclusion of parent education level of the student taking the exam.[26] Analogous information is collected for EOC exams but question regarding the reliability of the data recorded at the secondary level has lead NCDPI not to report these results.

As with the EOC exams, EOG exams have a state calculated composite score (the average test score for each district across all subject areas, including writing) that is reported. Those results are reported in Table V at each sub-sample level: 117 districts, 100 counties, and for the 88 "unified" districts/counties. As with the EOC analysis, specifications were conducted and evaluated at all grade levels and content areas, although only the composite test results are reported. Each model was specified as in Table V. Again, like the EOC results, most of the specifications failed to produce any significant private school competition effect, whether positive or negative (with one exception discussed below), however, several trends are worth noting.

Estimates at the 117 district and 88 "unified" district/county levels displayed similar patterns to those observed in the EOC analysis. Instrumental variables specifications failed to record any significant variables, with the lone exception of minority public school concentration, which exhibited the expected relationship (a negative impact on students performing at grade level or beyond)(see Table V). Both the private school and Catholic variable estimates were associated with large standard errors (again, White/robust standard errors) and were not significant. Catholic membership did demonstrate the expected positive relationship to private school participation in the first stage instrumental variables equations, albeit an insignificant one (see bottom of Table V). Parent education also exhibited the expected relationship throughout most specifications: as the percentage of students with parents with college education

[26] Parent education level is defined as those parents with at least some college education (two-year college, four year college, or having graduate degrees)(see Table V). The full listing of parent education levels is provided in Table I.

increased, the percentage of students scoring at or above grade level on EOG exams increased.[27]

Two patterns of note were the overall performance at the 100 county-level, and one incidence of a significant private school competition effect. First, the specifications at the 100 county-level exhibited the same trends as the other two sub-samples, with one important exception: the standard errors on all the variables of interest, in particular the private school enrollment and Catholic membership estimates, were significantly smaller than in either of the other two sub-samples. Note also that when Couch et al found significant private school competition effects they were analyzing test scores at the 100 county-level. This can also be seen in Table V, where nearly all of the standard errors are significantly lower at the 100 county-level, a trend not found in EOC analysis.

One possible explanation is that failure to adequately account for intergovernmental competition between city and county school districts may be introducing "noise" into the estimates. With the increasing importance of charter school education throughout North Carolina, especially at the elementary level, this may not be a trivial concern and needs to be addressed. Again, recall that by far the majority of North Carolina's private school students are concentrated at the elementary level: grades K-8 accounted for nearly 80 percent (79.4 percent) of total private school enrollment in 1998-1999.

A second note of interest in the 100 district/county level sub-sample, are two findings of nearly significant (at the 10 percent level of significancy) private school competition effects. Both occur in EOG math exams (at grades 3 and 7) and both occur only in OLS specifications. For a 10 percent increase in private school enrollment within the district/county there is a –3.91 (standard error = 0.23) percent or –3.40 percent (standard error = 0.19) reduction in the percentage of students scoring at or above grade level for

[27] Interestingly, parent education became less significant in specifications in the 88 county/district sub-sample than in either of the other two sub-samples, which both recorded fairly significant impacts on test scores, mostly in the OLS estimates.

grades 3 and 7 respectively.[28] So, the two lone incidences of private school competition effects are found only in math, the same metric of student performance chosen by Couch et al, and exhibits a negative impact on students performing at or above grade level, although the finding is not significant at conventional levels (5 or 1 percent). Still the result merits noting.

Dropout Rates: Analysis of the 117 Districts, 100 Counties and 88 "Unified" Districts

As mentioned previously, several researchers have found significant and beneficial impacts from private school competition on public school graduation rates and reductions in dropout rates (Altonji et al 2000; Dee 1998; Evans and Schwab 1995; Hoxby 1994[a]; Neal 1997 and 1998; and Sander and Krautman 1995). NCDPI produced two separate dropout rates for the 1998-1999 school year: for grades 7-12 (inclusive of middle school) and one for grades 9-12 (see footnote 21 above for the formal definition). Additionally, the State produces a student retention rate. All three rates were evaluated for all three sub-sample levels (117, 100 and 88).

Unlike the results of previous studies, there is no evidence of any significant private school competition effects on any of the three rates, regardless of sub-sample (117, 100, or 88) or specification (OLS or IV). Table V reports the dropout rate results for grades 9-12 in the final six columns of the table. Notice that the Catholic membership coefficient is right-signed (bottom of Table V), but again insignificant.

One trend that continued from the EOG analysis was the reduction in standard error sizes for estimates at the 100-district/county level sub-sample, especially for the Catholic membership and private school enrollment variables (see Table V).

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[28] OLS covariates are the same as those listed in Table V for EOG exams with Catholic membership and percent of adults over the age of 25 with college degrees being omitted. The percent of adults with college degrees, a county measure, was only used in one specification, the one displayed in Table V, the last EOG specification.

Instrument Validity

The literature has become increasingly concerned over the appropriateness of using Catholic membership, concentration/density, or proximity to Catholic institutions as legitimate instruments for analysis and overcoming issues of simultaneity. A recent study reviewed the use of Catholic variables (religious affiliation, proximity to Catholic schools, and interactions between affiliation and proximity) with two data sets, used frequently in this research: the National Educational Longitudinal Study of 1988 (NELS:88) and the National Longitudinal Study of the High School Class of 1972 (NLS-72)(Altonji et al 2002). While not finding uniformly consistent results, the authors did find that the three instruments evaluated in the NELS:88 data set produced biased estimates. The authors could not estimate the magnitude of the bias in the NLS-72 data set (Altonji 2002, p. 22).

Several authors within the literature, in particular Figlio and Stone (1999), have argued that Catholic membership is not truly exogenous to participation/enrollment in private schools, thus producing biased coefficient estimates (see also: Kane 1996; Murnane et al 1985; and Sander 1996). Figlio and Stone further contend that Catholic school students (those that are practicing Catholics) are *systematically* different, particularly in their student achievement, from their other non-Catholic public school student peers (Figlio and Stone 1999, p. 125).[29]

In contrast to this contention is a study by Sander (1996) of non-Hispanic white Catholic school students. Sander finds that, after controlling for issues of selection, an eight-year tenure in Catholic schools produces higher vocabulary, mathematics and reading scores (although no effect on science scores were found).[30] Further, Sander finds no evidence of

[29] Figlio and Stone propose two novel instruments in place of Catholic membership/concentration: union laws in states where analysis is being conducted. Specifically, they use whether a state has "duty to bargain" or "right to work" laws, and then interact these with (i) median county income, and (ii) the student's family socioeconomic status. The authors maintain that these instruments are correlated with school sector choice (they use a multinomial logit three-sector (public, private-religious, private-nonreligious) choice model) but independent of the unexplained variation (the error term) in the student achievement equation (Figlio and Stone 1999, p. 121).

[30] In personal communication with the author, several economists have noted off-handedly that there may be economies of scale at work in public school science departments and curriculum, which may account for

positive selection (the "cream skimming" scenario) into Catholic schools, and, most importantly for Figlio and Stone's contention, Sander found the achievement gains were being driven by *non-Catholic* (non-practicing Catholics within Catholic schools) students (Sander 1996, p. 545). Once these non-Catholic students left Catholic institutions, their student achievement gains fell to zero. This finding stands in stark contrast to Figlio and Stone's contention that Catholics systematically out perform many other student groups.

A further consideration is the technical performance of the instrument itself. Bound et al (1995) have argued finding valid instruments may be much more difficult than previously thought. First, the authors contend that if the chosen instruments (Catholic membership in this case) explain little of the variation in the endogenous variable (private school enrollment), there may exits large inconsistencies between IV estimates and those produced by OLS, even if the correlation between the instruments and the unexplained variation (the error term in the student achievement equation) is weak. Their second contention is that the instrumental variables estimates will be biased in the same direction as the OLS estimates.

The lack of explanatory power in the chosen instruments has particular relevance in this study of North Carolina data, specifically when considering the relatively small concentration of Catholics within the state. While the Catholic population within North Carolina is one of the fastest growing demographic groups,[31] with private school education being largely provided by religious institutions, Catholic schools represent a minority segment of the private school market.[32] The hypothesized relationship of a positive relationship between Catholic concentration and public school provision may

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some of the achievement differentials in this content area between public and private school students. I have not found this argument made formally in the literature.

[31] Primarily for two reasons: (1) the exponential growth of the Hispanic population within North Carolina; and (2), the continued migration of Northern residents into North Carolina.

[32] For 1998-1999: Total private schools = 626 (independent/secular = 193 (30.8%), religious = 433 (69.2%)); total private school enrollment = 84,384 (independent/secular = 25,162 (29.8%), religious = 59,222 (70.2%)). School figures do not include special (27 schools), home or charter schools, and enrollment figures do not include home or charter school enrollment (but do include private special school enrollment). See:
http://www.doa.state.nc.us/dnpe/hhh548.htm

indeed exist, however, the lack of critical Catholic masses within the state may be significantly reducing the instruments power and efficacy.

A series of Hausman tests were conducted to see if there were systematic differences between the OLS and instrumental variables specifications. In several cases, estimates failed to reject the null hypothesis,[33] indicating that the instrumental variables are not systematically different from the OLS estimates. It appears that using Catholic membership as an instrument for private school enrollment did not insulate the variable from simultaneity bias and may not have aided the analysis. In this instance, the coefficient estimates may be even more inefficient than the OLS results when not accounting for endogenity.

Another explanation for the disparity in findings across studies and within this current study is the issue of aggregation. Jepsen has recently found (2001) that research estimating the effects of private school competition will have coefficient estimates that are highly sensitive to the data set, the grade level, the level of aggregation of the competition variable employed, and whether OLS or instrumental variables techniques are used. The metric of private school competition chosen (enrollment vs. percent of private schools in an area for instance) can have significant impacts on estimates (Jepsen 2001, pp. 17-18). That coupled with limitations of the instrument may account for the insignificant results.

VIII. Conclusions

This study has produced several results that can help inform the larger body of research while contributing to the school choice discussion. First, no significant private school competition effects (with the exception of the marginally significant, but noteworthy EOG math exams at grades 3 and 7) were found, regardless of the specification, sub-sample or measure of student performance employed. Second, as an attempt to duplicate Couch et al's study, the current study made allowances for several elements (endogeneity, expanding the measure of student outcomes, and by specifying models

[33] H_0 = differences in coefficient estimates are not systematic.

with extended controls), but still failed to produce similar findings. Third, several patterns found in the larger literature emerged within this study: there is slight evidence that African American public school students may be more sensitive to private school competition than other ethnic groups; and there is no evidence in this data set of the competition effect being age-specific or concentrated within a specific grade level.

The findings also help to advance and contribute to the larger research in several areas where it demonstrated limitations or failure to produce results. First, the need to account for selection: since this study sought to account for endogeneity and duplicate Couch et al's results, a selection model was not employed. The lack of significant effects may be, in part, attributable to the lack of control for student sorting and selection between schools.

Another aspect to consider is the role played by intergovernmental competition. Competition between public institutions has become a research focus of late, and may include competition between schools (public vs. charter) or take the form of multi-districting and open enrollment policies (see Taylor 2000 for a review of the literature; Blair and Staley 1995; Borland and Howsen 1992, 1993 & 2000; Epple and Romano 1998; Hoxby 1994[b] & 2000; Kenyon 1997; and Zanzig 1997). Considering North Carolina's increasing number of charter schools, failure to find a significant private school competition effect may be due parents and students exercising school choice in terms of charter school preferences.[34]

A recent study by Holmes, DeSimone and Rupp (2003) has found that introduction of charter school competition in North Carolina lead to an approximate one percent increase

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[34] However, total charter school enrollment (K-12) for 1998-1999 was substantially smaller than total private school enrollment (K-12): 8,234 and 84,384 respectively.
http://www.ncpublicschools.org/fbs/stats/pdf/1999p1.pdf
http://www.doa.state.nc.us/dnpe/hhh548.htm
Since the 1998-1999 academic year total charter school enrollment (K-12) has risen by nearly 111 percent to 17,354 while total private school enrollment (K-12) has increased by approximately 9 percent to 91,817 in 2001-2002.
http://www.ncpublicschools.org/fbs/stats/StatProfile02.pdf
http://www.doa.state.nc.us/dnpe/hhh551.htm

in test scores for traditional public school students, and accounts for nearly one quarter of the mean standard deviation of observed gains (Holmes et al 2003, p. 15). The authors use several models (standard cross-section, IV panel, and maximum likelihood models), and the results are robust across specifications, indicating that charter school competition may account for more of the competition effects in North Carolina than private schools. However, when charter school enrollment was included as the metric of competition in this study, regardless of public school student outcome used, the results failed to produce any significant competition effects.

Finally, decisions to use instrumental variables approaches and whether or not to use Catholic membership or related measures to instrument for private school competition is an open question. Several authors have used this approach fruitfully and on different data sets, however questions remain. Differences of aggregation may explain some of the divergence in empirical results. The literature has not arrived at a consensus regarding this issue. Fruitful research will need to address and expand these issues to help inform our understanding of school choice and its implications for America's educational system.

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Table I
Descriptive Statistics
NC Public School Data, 1998-1999

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Public School End-of-Course Exams*					
Algebra I (%)	117	65.8	12.10	22.1	90.7
Biology (%)	117	57.7	9.83	16.7	80.3
Economic, Legal, and Political Systems (ELPS) (%)	117	68.4	8.94	29.3	96.7
U.S. History (%)	117	48.6	10.33	15.7	86.6
Composite Test Score Average (all subjects) (%)	117	57.6	9.69	25.4	83.9
Average Test Score of Four Required Subjects, All Students (%)	117	60.1	7.47	27.1	81.7
Average Test Score of Four Required Subjects, Blacks Only (%)	103**	40.8	6.82	23.8	59.3
Public School End-of-Grade Exams*					
Composite Test Score Average (all subjects) (%)	117	75.0	5.40	54.5	90.0
Public School Dropout Rate					
Grades 9-12 Duplicate Dropout Rate (%)	117	6.8	1.44	2.3	11.3
School District Enrollment					
Catholic Membership (%)	117	5.8	4.05	0	22.5
Public School Enrollment (%)	117	93.0	4.43	84.0	100
Chater School Enrollment (%)	117	0.6	1.03	0	13.4
Private School Enrollment (%)	117	6.3	4.12	0	13.4
School District Level Data					
Number of Children (age 5-17) in Poverty, 1997 (%)	117	16.6	4.76	9.4	33.7
Median Household Income ($)	117	36,332	6,879.26	21,616	51,391
Adults Over 25 with a College Degree in 1990 (%)	117	17.7	9.22	6.6	46.10
Population Density	117	406.3	371.47	9.5	1321.5
Parent's Education of Student's Taking EOG Exams					
Did Not Finish High School (%)	117	11.1	5.11	3.1	33.9
High School Graduate (%)	117	43.9	9.38	11.9	64.7
Trade/Business School (%)	117	4.8	1.29	1.1	10.6
Community College (%)	117	13.8	2.73	4.9	26.1
Four Year College (%)	117	21.0	9.89	6.5	43.9
Graduate School (%)	117	5.3	4.65	0.4	44.5
Public School Data					
Total Per Pupil Expenditure ($)	117	5,910	519.66	5,121	10,269
Per Pupil Capital Expenditure, 5 Year Avg. ($)	117	669	360.16	122	2,204
Number of Violent Acts, per 1000	117	6.26	2.07	0.90	15.60
Black Public School Enrollment (%)	117	31.3	17.54	0.2	93.9
Hispanic Public School Enrollment (%)	117	3.1	2.08	0.1	12.4
American Indian Public School Enrollment (%)	117	1.5	6.02	0	43.6
Asian Public School Enrollment (%)	117	1.7	1.77	0	9.1
White Public School Enrollment (%)	117	62.4	18.92	5.6	98.9
Public School Teacher Data					
Teachers with Less than Bachelors Degree (%)	117	0.1	0.14	0	1.5
Teachers with Bachelor (%)	117	63.7	5.30	45.2	75.7
Teachers with Masters (%)	117	33.5	4.93	20.6	51.0
Teachers with Sixth Year Level (%)	117	2.1	0.97	0.5	6.8
Teachers with Doctorate (%)	117	0.7	0.38	0	4.2
Teachers with No Prior Experience (%)	117	7.5	2.13	1.5	22.2

Notes: See the Data Appendix for variable information.

All values weighted by total school district population (public, charter, and private).

* End-of-Course and End-of Grade exams are percent of students scoring at Level III or higher for the district.

** North Carolina did not report scores if fewer than 5 students took the exam. Fourteen districts did not report EOC scores for their African American populations in 1998-1999. Of the four required subjects (Algebra I, Biology, ELPS and U.S. History), the following are the 14 LEAs and the EOC exams not reported for African American students in 1998-1999: Alleghany County (Algebra I, Biology, ELSP and U.S. History); Ashe County (Algebra I, Biology, ELSP and U.S. History); Avery County (Algebra I, Biology, ELSP and U.S. History); Cherokee County (Biology, ELPS, and U.S. History); Clay County (Algebra I, Biology, ELSP and U.S. History); Dare County (ELPS); Graham County (Algebra I, Biology, ELSP and U.S. History); Jackson County (Algebra I, Biology, ELSP and U.S. History); Macon County (U.S. History); Madison County (Algebra I, Biology, ELSP and U.S. History); Mitchell County (Algebra I, Biology, ELSP and U.S. History); Swain County (Algebra I, Biology, ELSP and U.S. History); Watauga County (Algebra I, Biology, ELSP and U.S. History); and Yancey County (Algebra I, Biology, ELSP and U.S. History).

Table II

117 North Carolina School Districts Using End-of-Course Test Score Results, 1998-1999

	State Composite Test Score		Algebra I		Biology		ELPS		U.S. History		Avg. Test Score of Four Required Subjects	
Explanatory Variable	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Constant	98.13***	98.66***	81.41***	81.08***	46.85***	45.83	82.16***	83.21***	60.50***	59.48**	67.28***	67.47**
	(20.50)	(21.20)	(20.89)	(20.65)	(15.89)	(81.07)	(15.94)	(20.41)	(19.41)	(32.28)	(12.61)	(29.83)
Private School Enrollment	***0.31***	***0.74***	***0.67***	***1.54***	***0.002***	***13.17***	***0.36***	***1.45***	***0.17***	***4.37***	***0.33***	***4.67***
	(0.36)	***(4.65)***	***(0.41)***	***(6.01)***	***(0.26)***	***(42.63)***	***(0.27)***	***(7.33)***	***(0.39)***	***(15.89)***	***(0.22)***	***(12.65)***
Nonwhite Public School Enrollment	-0.22**	-0.22**	-0.31	-0.32***	-0.48***	-0.52	-0.21***	-0.22**	-0.25***	-0.29	-0.31***	-0.34**
	(0.09)	(0.09)	(0.09)	(0.11)	(0.07)	(0.34)	(0.08)	(0.09)	(0.08)	(0.19)	(0.05)	(0.14)
Total Per Pupil Expenditure ($1000's)	1.39	1.35	-3.14	-3.16	-2.12	-1.97	-0.84	-1.12	2.83	2.71	-0.62	-0.94
	(1.81)	(1.84)	(2.52)	(2.36)	(1.46)	(8.58)	(1.65)	(2.27)	(2.19)	(3.69)	(1.10)	(2.75)
Per Pupil Capital Exp., 5 Yr. Avg.	-1.81	-0.88	0.96	2.91	-1.22	29.46	1.37	3.96	-3.18	6.65	-0.26	9.82
($1000's)	(3.64)	(9.90)	(3.07)	(13.51)	(2.64)	(100.66)	(3.24)	(16.61)	(3.38)	(37.46)	(2.22)	(29.85)
Teacher Degree	0.44	0.46	-0.09	-0.04	0.07	0.82	-0.11	-0.04	0.62**	0.84	0.11	0.36
	(0.28)	(0.34)	(0.20)	(0.35)	(0.20)	(2.45)	(0.20)	(0.48)	(0.24)	(0.86)	(0.15)	(0.74)
No Prior Teaching Experience	0.97	1.02	-0.35	-0.22	0.45	2.10	-0.21	-0.09	0.91	1.50	0.22	0.79
	(0.59)	(0.77)	(0.67)	(1.05)	(0.40)	(5.49)	(0.38)	(0.98)	(0.60)	(2.45)	(0.37)	(1.79)
No.# of Public School Violent Acts,	-0.10	-0.10	0.03	0.03	-0.36	-0.17	0.26	0.30	0.28	0.34	0.13	0.20
per 1000	(0.33)	(0.33)	(0.33)	(0.32)	(0.27)	(1.59)	(0.37)	(0.40)	(0.36)	(0.63)	(0.22)	(0.53)
Number of Poor Kids (5-17), 1997	-0.85	-0.91	-0.04	-0.16	0.83**	-1.29	-0.15	-0.31	-0.45	-1.004	0.03	-0.58
	(0.52)	(0.88)	(0.56)	(1.04)	(0.34)	(7.53)	(0.40)	(1.18)	(0.51)	(2.40)	(0.31)	(2.01)
Median Income ($1000's)	-1.46***	-1.49***	0.46	0.42	0.43	-0.31	-0.05	-0.11	-1.37	-1.60	-0.14	-0.38
	(0.50)	(0.54)	(0.35)	(0.53)	(0.26)	(2.89)	(0.27)	(0.52)	(0.48)	(1.07)	(0.24)	(0.91)
Adults over 25 with a College Degree	0.14	0.08	0.51***	0.38	0.57***	-1.54	0.41**	0.24	0.21	-0.46	0.40***	-0.28
in 1990	(0.21)	(0.77)	(0.19)	(0.92)	(0.16)	(6.87)	(0.16)	(1.11)	(0.22)	(2.54)	(0.13)	(1.98)
Population Density	0.002	-0.001	-0.03***	-0.03	-0.003	-0.11	-0.01***	-0.02	0.01**	-0.02	-0.01**	-0.04
	(0.01)	(0.04)	(0.01)	(0.05)	(0.01)	(0.35)	(0.004)	(0.06)	(0.01)	(0.13	(0.003)	(0.10)
Adj. R^2	0.405	-	0.538	-	0.621	-	0.356	-	0.382	-	0.569	-
AIC	813.210	-	841.295	-	762.599	-	790.573	-	834.857	-	720.552	-
N	117	117	117	117	117	117	117	117	117	117	117	117
Catholic Membership (First Stage Result)	-	0.067	-	0.051	-	0.036	-	0.042	-	0.040	-	0.043
	-	(0.104)	-	(0.103)	-	(0.102)	-	(0.100)	-	(0.103)	-	(0.102)

Notes: Robust standard errors in parentheses. *Nonwhite Public School Enrollment* = a variable representing the summation of all four public school race groups (Black, Asian, Hispanic, and American Indian). The omitted group is White for allspecifications. *Teacher Degree* = a variable representing the highest degree attained by public school educators (masters, sixth year level, and doctors). Omitted group = teachers with less than bachelors, and bachelors degrees for all specifications. *Instrument* = school district level Catholic membership (2000 Census); figures adjusted by the author. *Avg. Test Score* = average of the four required subjects (Algebra I, biology, ELPS, and U.S. History) school district EOC score for the 1998-1999 academic year. All specifications have been weighted by the number of students taking the particular EOC subject exam during the 1998-1999 academic year, except *State Composite Test Score* which is weighted by total public school student population. The number of students taking EOC exams in the 1998-1999 academic year were: Algebra I (87,404); biology (76,872); ELPS (77,740); and U.S. History (70,187). Significant at the one (***), five (**), or ten (*) percent levels. See Data Appendix for additional variable information.

Table III
100 North Carolina Counties Using End-of-Course Test Score Results, 1998-1999

	State Composite Test Score		Algebra I		Biology		ELPS		U.S. History		Avg. Test Score of Four Required Subjects	
Explanatory Variable	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Constant	125.90***	123.81***	112.16***	111.54***	64.09**	70.66	68.56**	71.29**	82.70***	80.47**	79.12***	80.17***
	(33.38)	(32.74)	(34.55)	(35.89)	(24.27)	(54.94)	(26.30)	(31.90)	(30.21)	(33.95)	(21.44)	(23.09)
Private School Enrollment	***0.36***	***-0.95***	***0.78***	***0.27***	***-0.29***	***4.90***	***0.41***	***1.53***	***0.10***	***-1.91***	***0.28***	***0.99***
	(0.44)	***(3.31)***	***(0.53)***	***(3.75)***	***(0.27)***	***(8.95)***	***(0.34)***	***(4.22)***	***(0.47)***	***(4.74)***	***(0.28)***	***(2.76)***
Nonwhite Public School Enrollment	-21.84**	-20.98**	-31.86***	-31.22***	-50.68***	-53.32***	-24.37***	-25.29***	-25.05***	-23.11**	-32.85***	-33.49***
	(9.75)	(10.14)	(9.57)	(10.33)	(7.67)	(15.85)	(8.16)	(8.90)	(8.19)	(9.52)	(5.57)	(6.15)
Total Per Pupil Expenditure ($1000's)	1.19	1.20	-4.17	-4.17	-2.41	-1.98	-0.45	-0.64	3.23	3.10	-0.68	-0.68
	(1.92)	(1.92)	(2.71)	(2.85)	(1.51)	(3.52)	(1.86)	(1.98)	(2.52)	(2.50)	(1.15)	(1.18)
Per Pupil Capital Exp., 5 Yr. Avg.	-2.59	-4.52	0.65	-0.12	-2.62	5.49	-0.28	1.45	-4.53	-7.67	-1.53	-0.43
($1000's)	(3.49)	(5.58)	(3.35)	(6.41)	(2.68)	(15.33)	(3.74)	(6.65)	(3.37)	(8.37)	(2.22)	(4.96)
Teacher Degree	0.28	0.27	-0.29	-0.29	-0.12	-0.07	-0.14	-0.13	0.44*	0.42	-0.03	-0.02
	(0.31)	(0.33)	(0.26)	(0.26)	(0.23)	(0.46)	(0.23)	(0.26)	(0.24)	(0.30)	(0.18)	(0.18)
No Prior Teaching Experience	1.09*	1.03	-0.57	-0.60	0.52	0.67	-0.03	0.006	1.07	0.96	0.29	0.33
	(0.65)	(0.72)	(0.83)	(0.87)	(0.43)	(0.89)	(0.44)	(0.51)	(0.68)	(0.77)	(0.41)	(0.40)
No.# of Public School Violent Acts,	-0.11	-0.21	0.19	0.14	-0.57**	-0.13	0.35	0.49	0.14	-0.03	0.08	0.15
per 1000	(0.36)	(0.46)	(0.38)	(0.44)	(0.27)	(0.95)	(0.41)	(0.59)	(0.40)	(0.66)	(0.23)	(0.28)
Number of Poor Kids (5-17), 1997	-1.36*	-1.16	-0.41	-0.34	0.72	-0.11	0.14	-0.03	-0.90	-0.61	-0.09	-0.19
	(0.71)	(0.87)	(0.78)	(1.06)	(0.45)	(1.86)	(0.49)	(0.79)	(0.70)	(1.12)	(0.43)	(0.55)
Median Income ($1000's)	-1.90***	-1.84***	0.08	0.10	0.25	0.02	0.17	0.11	-1.72***	-1.63**	-0.29	-0.32
	(0.64)	(0.65)	(0.52)	(0.57)	(0.35)	(0.90)	(0.39)	(0.47)	(0.63)	(0.74)	(0.33)	(0.36)
Adults over 25 with a College Degree	0.29	0.48	0.64***	0.71	0.75***	-0.06	0.41**	0.25	0.34	0.65	0.51***	0.40
in 1990	(0.24)	(0.59)	(0.19)	(0.59)	(0.15)	(1.33)	(0.17)	(0.61)	(0.25)	(0.81)	(0.13)	(0.43)
Population Density	0.003	0.01	-0.02***	-0.02	0.001	-0.04	-0.01**	-0.02	0.01*	0.03	-0.01	-0.01
	(0.007)	(0.02)	(0.01)	(0.03)	(0.005)	(0.07)	(0.004)	(0.03)	(0.01)	(0.04)	(0.003)	(0.02)
Adj. R^2	0.424	-	0.545	-	0.672	-	0.338	-	0.405	-	0.576	-
AIC	688.250	-	716.124	-	632.832	-	670.752	-	703.660	-	608.043	-
N	100	100	100	100	100	100	100	100	100	100	100	100
Catholic Membership (First Stage Result)	-	0.130	-	0.117	-	0.08	-	0.111	-	0.102	-	0.104
	-	(0.119)	-	(0.120)	-	(0.118)	-	(0.117)	-	(0.120)	-	(0.119)

Notes: Robust standard errors in parentheses. *Nonwhite Public School Enrollment* = a variable representing the summation of all four public school race groups (Black, Asian, Hispanic, and American Indian). The omitted group is White for allspecifications. *Teacher Degree* = a variable representing the highest degree attained by public school educators (masters, sixth year level, and doctors). Omitted group = teachers with less than bachelors, and bachelors degrees for all specifications. *Instrument* = county level Catholic membership (2000 Census). *Avg. Test Score* = average of the four required subjects (Algebra I, biology, ELPS, and U.S. History) school district EOC score for the 1998-1999 academic year. All specifications have been weighted by the number of students taking the particular EOC subject exam during the 1998-1999 academic year, except *State Composite Test Score* which is weighted by total public school student population. The number of students taking EOC exams in the 1998-1999 academic year were: Algebra I (87,404); biology (76,872); ELPS (77,740); and U.S. History (70,187). Significant at the one (***), five (**), or ten (*) percent levels. See Data Appendix for additional variable information.

Table IV
88 North Carolina Unified Counties Using End-of-Course Test Score Results, 1998-1999

	State Composite Test Score		Algebra I		Biology		ELPS		U.S. History		Avg. Test Score of Four Required Subjects	
Explanatory Variable	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Constant	128.66***	119.51**	143.28***	135.90	71.28**	209.52	79.87***	92.58	58.04**	44.65	85.98***	96.43*
	(35.74)	(59.26)	(39.78)	(81.60)	(29.32)	(1707.29)	(26.85)	(66.03)	(25.90)	(86.24)	(24.05)	(55.62)
Private School Enrollment	***0.27***	***-2.10***	***0.83***	***-1.40***	***-0.41***	***38.04***	***0.47***	***4.69***	***-0.04***	***-4.72***	***0.24***	***3.51***
	(0.53)	***(10.78)***	***(0.68)***	***(15.83)***	***(0.32)***	***(444.81)***	***(0.38)***	***(13.01)***	***(0.56)***	***(20.54)***	***(0.33)***	***(12.58)***
Nonwhite Public School Enrollment	-24.25**	-22.97**	-30.58***	-28.26*	-53.29***	-68.24	-29.47***	-32.92**	-28.20***	-24.08	-35.01***	-37.58***
	(10.00)	(11.29)	(10.65)	(15.86)	(8.97)	(159.46)	(8.75)	(14.81)	(8.27)	(17.64)	(5.77)	(12.39)
Total Per Pupil Expenditure ($1000's)	1.88	2.07	-3.52	-3.43	-2.32	-1.10	-0.24	-1.12	3.56	3.49	-0.31	-0.49
	(1.79)	(2.24)	(2.61)	(3.16)	(1.52)	(30.80)	(1.93)	(3.62)	(2.20)	(3.44)	(1.13)	(2.15)
Per Pupil Capital Exp., 5 Yr. Avg.	-4.21	-8.74	3.21	-1.07	-3.79	69.34	-0.66	7.68	-9.08**	-17.83	-2.36	3.91
($1000's)	(4.05)	(20.80)	(3.63)	(31.71)	(3.43)	(859.24)	(4.23)	(26.53)	(3.61)	(39.10)	(2.52)	(25.33)
Teacher Degree	-0.11	-0.14	-0.62**	-0.64*	-0.34	-0.11	-0.49*	-0.39	0.16	0.11	-0.33	-0.29
	(0.35)	(0.39)	(0.28)	(0.33)	(0.29)	(3.78)	(0.27)	(0.53)	(0.26)	(0.46)	(0.18)	(0.33)
No Prior Teaching Experience	0.74	0.72	-0.58	-0.62	0.44	-0.14	-0.17	-0.20	0.69	0.62	0.14	0.15
	(0.66)	(0.87)	(0.83)	(1.01)	(0.45)	(9.80)	(0.46)	(0.83)	(0.69)	(1.08)	(0.42)	(0.51)
No.# of Public School Violent Acts,	0.04	-0.23	0.36	0.12	-0.49	3.26	0.49	1.00	0.02	-0.45	0.14	0.49
per 1000	(0.43)	(1.31)	(0.48)	(1.89)	(0.33)	(44.32)	(0.51)	(1.73)	(0.48)	(2.15)	(0.26)	(1.40)
Number of Poor Kids (5-17), 1997	-1.01	-0.58	-0.86	-0.48	0.78	-6.52	0.33	-0.27	-0.02	0.78	0.07	-0.48
	(0.80)	(2.32)	(0.97)	(3.46)	(0.61)	(88.02)	(0.55)	(2.35)	(0.64)	(4.08)	(0.52)	(2.31)
Median Income ($1000's)	-1.81***	-1.59	-0.67	-0.47	0.22	-3.17	-0.01	-0.35	-0.90*	-0.54	-0.33	-0.61
	(0.66)	(1.29)	(0.61)	(1.93)	(0.47)	(42.19)	(0.40)	(1.49)	(0.52)	(2.05)	(0.38)	(1.34)
Adults over 25 with a College Degree	0.28	0.57	1.05***	1.34	0.80***	-4.41	0.60	0.06	0.02	0.65	0.60***	0.17
in 1990	(0.26)	(1.45)	(0.19)	(1.96)	(0.18)	(59.45)	(0.19)	(1.58)	(0.24)	(2.82)	(0.13)	(1.57)
Population Density	0.01	0.03	-0.02***	-0.01	0.01	-0.28	-0.01	-0.04	0.02**	0.05	-0.002	-0.03
	(0.01)	(0.08)	(0.01)	(0.12)	(0.01)	(3.31)	(0.01)	(0.10)	(0.01)	(0.15)	(0.004)	(0.10)
Adj. R^2	0.385	-	0.516	-	0.644	-	0.296	-	0.350	-	0.493	-
AIC	609.186	-	638.180	-	564.703	-	596.509	-	622.893	-	538.054	-
N	88	88	88	88	88	88	88	88	88	88	88	88
Catholic Membership (First Stage Result)	-	0.060	-	0.047	-	0.014	-	0.061	-	0.043	-	0.041
	-	(0.132)	-	(0.132)	-	(0.131)	-	(0.128)	-	(0.133)	-	(0.131)

Notes: Robust standard errors in parentheses. *Nonwhite Public School Enrollment* = a variable representing the summation of all four public school race groups (Black, Asian, Hispanic, and American Indian). The omitted group is White for allspecifications. *Teacher Degree* = a variable representing the highest degree attained by public school educators (masters, sixth year level, and doctors). Omitted group = teachers with less than bachelors, and bachelors degrees for all specifications. *Instrument* = county level Catholic membership (2000 Census). *Avg. Test Score* = average of the four required subjects (Algebra I, biology, ELPS, and U.S. History) school district EOC score for the 1998-1999 academic year.

All specifications have been weighted by the number of students taking the particular EOC subject exam during the 1998-1999 academic year, except *State Composite Test Score* which is weighted by total public school student population. The number of students taking EOC exams in the 1998-1999 academic year were: Algebra I (87,404); biology (76,872); ELPS (77,740); and U.S. History (70,187). Significant at the one (***), five (**), or ten (*) percent levels. See Data Appendix for additional variable information.

Table V
Alternative Specifications for 1998-1999

	Black EOC Test Scores, Avg. of Four Required Subjects			End-of-Grade (3rd-8th) State Composite Test Score			Grades 9-12 Public School Duplicate Dropout Rate					
Explanatory Variable	**IV**	**IV**	**IV**	**IV**	**IV**	**IV**	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Constant	78.57***	74.34**	90.00**	76.03**	85.72***	90.77	11.42***	10.20	13.31***	12.20	12.72***	5.33
	(20.41)	(33.69)	(44.04)	(30.95)	(27.53)	(63.03)	(3.05)	(7.81)	(4.32)	(7.96)	(4.41)	(33.14)
Private School Enrollment	***-2.10***	***-1.79***	***-2.77***	***-0.23***	***1.66***	***1.44***	***0.05***	***-0.98***	***0.03***	***-0.73***	***0.02***	***-1.97***
	(2.06)	***(1.73)***	***(3.31)***	***(5.48)***	***(3.14)***	***(6.73)***	***(0.06)***	***(2.18)***	***(0.08)***	***(1.13)***	***(0.09)***	***(5.91)***
Nonwhite Public School Enrollment	-0.23*	-25.46**	-29.08	-0.20	-25.85***	-26.57**	0.01	0.01	1.50	2.02	1.43	2.55
	(0.13)	(12.35)	(20.88)	(0.14)	(8.56)	(11.34)	(0.02)	(0.03)	(1.67)	(2.15)	(1.64)	(4.72)
Total Per Pupil Expenditure ($1000's)	-0.56	-0.99	-0.78	-1.32	-2.49*	-2.15	-0.19	-0.09	-0.17	-0.17	0.05	0.20
	(2.11)	(2.00)	(2.63)	(2.32)	(1.38)	(1.56)	(0.38)	(0.70)	(0.42)	(0.65)	(0.41)	(1.25)
Per Pupil Capital Exp., 5 Yr. Avg.	-7.52	-6.66	-7.64	-0.77	1.98	1.37	-0.25	-2.53	0.07	-1.05	0.01	-3.80
($1000's)	(5.80)	(5.10)	(9.56)	(11.75)	(4.79)	(14.74)	(0.56)	(4.96)	(0.62)	(1.98)	(0.53)	(12.28)
Teacher Degree	-0.79*	-0.64*	-0.74	-0.13	-0.17	-0.25	0.01	-0.04	0.02	0.01	0.005	-0.02
	(0.43)	(0.33)	(0.49)	(0.14)	(0.20)	(0.17)	(0.04)	(0.11)	(0.04)	(0.07)	(0.04)	(0.14)
No Prior Teaching Experience	-0.52	0.12	0.33	-0.57	-0.31	-0.48	0.08	-0.04	0.08	0.04	0.07	0.05
	(0.63)	(0.79)	(1.18)	(0.85)	(0.40)	(0.43)	(0.08)	(0.31)	(0.09)	(0.18)	(0.09)	(0.37)
No.# of Public School Violent Acts,	0.20	0.04	-0.01	-0.06	0.34	0.29	0.06	0.06	0.06	-0.003	-0.06	-0.29
per 1000	(0.44)	(0.46)	(0.68)	(0.16)	(0.38)	(0.83)	(0.07)	(0.14)	(0.08)	(0.18)	(0.07)	(0.79)
Number of Poor Kids (5-17), 1997	0.49	0.47	0.38	0.41	0.29	0.21	-0.04	0.12	-0.11	0.004	-0.08	0.27
	(0.76)	(0.89)	(1.41)	(0.73)	(0.67)	(1.64)	(0.07)	(0.44)	(0.08)	(0.30)	(0.09)	(1.36)
Median Income ($1000's)	-0.17	-0.23	-0.65	0.24	0.11	0.11	-0.12**	-0.06	-0.17**	-0.14	-0.17**	0.02
	(0.34)	(0.51)	(0.83)	(0.56)	(0.41)	(1.34)	(0.05)	(0.20)	(0.07)	(0.14)	(0.08)	(0.82)
Adults over 25 with a College Degree	0.93*	0.95**	1.36	-	-	0.13	-0.06	0.10	-0.06	0.05	-0.04	0.22
in 1990	(0.51)	(0.45)	(0.97)	-	-	(0.31)	(0.04)	(0.34)	(0.04)	(0.16)	(0.05)	(0.68)
Population Density	0.01	0.01	0.01	-0.0002	-0.01	-0.01	0.002**	0.01	0.002**	0.01	0.002**	0.02
	(0.02)	(0.01)	(0.02)	(0.04)	(0.02)	(0.05)	(0.001)	(0.02)	(0.001)	(0.01)	(0.001)	(0.05)
Parent's Education	-	-	-	0.25	0.12	0.13	-	-	-	-	-	-
	-	-	-	(0.37)	(0.26)	(0.31)	-	-	-	-	-	-
Adj. R^2	-	-	-	-	-	-	0.244	-	0.263	-	0.287	-
AIC	-	-	-	-	-	-	396.622	-	329.308	-	289.093	-
N	103	86	74	117	100	88	117	117	100	100	88	88
Observation Unit Size	School Dist.	100 Counties	88 Unified	School Dist.	100 Counties	88 Unified	117 School Districts		100 Counties		88 Unified Counties	
Catholic Membership (First Stage Result)	0.165	0.244	0.227	0.024	0.103	0.045	-	0.068	-	0.130	-	0.061
	(0.121)	(0.148)	(0.178)	(0.109)	(0.124)	(0.138)	-	(0.105)	-	(0.119)	-	(0.132)

Notes: Robust standard errors in parentheses. Variables as in Tables II-IV. *Parent Education* = summation of EOG student's parent's education level (two-year college+four year college+ graduate degree). *Instrument* = school district (117)/county level (100 & 88) Catholic membership (2000 Census). *EOG State Composite Test Scores* = the average of 3rd-8th grade reading and math exams, and 4th and 7th grade writing exams for each LEA. All specifications weighted by total public school students (excluding charters), except dropout rates which *include* chater school students. Significant at the one (***), five (**), or ten (*) percent levels. See Data Appendix for additional variable information.

Data Appendix

VARIABLE	DESCRIPTION
Catholic Membership	Percent school district Catholic membership. Sources: Roman Catholic Diocese of Charlotte, and Roman Catholic Diocese of Raleigh; based on 2000 Census.
Public School Enrollment, 1998-1999	Percent public school students of total district students. Total students = sum of public, charter, and private enrollment, 1998-1999. Source: *The North Carolina Statistical Profile, 1999* www.ncpublicschool.org/fbs/stats/pdf/1999p1.pdf
Charter School Enrollment, 1998-1999	Percent charter school students of total district students. Total students = sum of public, charter, and private enrollment, 1998-1999. Source: *The North Carolina Statistical Profile, 1999* www.ncpublicschool.org/fbs/stats/pdf/1999p1.pdf
Private School Enrollment, 1998-1999	Percent county private school enrollment of total students. Source: *State of North Carolina Private School Statistics* www.doa.state.nc.us/dnpc/hhh548.htm
Number of Public School Violent Acts, per 1000, 1998-1999	The rate is calculated by dividing the total number of all acts committed by total student membership as of June 1999 and then multiplying by 1000. Source: *A Report Card for the ABCs of Public Education Volume II, 1999-2000: Subgroup Statistics and Supplemental Data* (NCDPI 2000, pp. 1-193). www.ncpublicschools.org/Accountability/reporting/reportcard/2000/SupplementalData.pdf
Total Per Pupil Expenditure, and Per Pupil Capital Expenditure (5 Year Avg.), 1998-1999	Per pupil expenditures by school district in thousands of dollars, 1998-1999. Source: *The North Carolina Statistical Profile, 2000* www.ncpublicschools.org/fbs/stats/pdf/2000p2.pdf
White, Black, Hispanic, American Indian, and Asian Public School Enrollment, 1998-1999	Percent school district public school enrollment (excludes charters, but includes special education enrollment). Source: *The North Carolina Statistical Profile, 2000* www.ncpublicschools.org/fbs/stats/pdf/2000p2.pdf
Public School End-of-Course (EOC) Exam Scores: Algebra I, Algebra II, Biology, Chemistry, English I, English II, ELPS, Geometry, Physical Science, Physics, U.S. History and Composite, 1998-1999	Percent of students taking exam scoring at Achievement Level III or better. Source: *A Report Card for the ABCs of Public Education Volume II 1998-99: End-of-Course Subgroup Statistics by School System* www.ncpublicschools.org/Accountability/reporting/reportcard/1999/index.html
Public School End-of-Grade (EOG) Exam Scores: 3rd - 8th Reading, 3rd - 8th Mathematics, 4th & 7th Writing, and Composite, 1998-1999	Percent of students taking exam scoring at Achievement Level III or better. Source: *A Report Card for the ABCs of Public Education Volume II 1998-99: End-of-Course Subgroup Statistics by School System* www.ncpublicschools.org/Accountability/reporting/reportcard/1999/index.html
Average Test Score of Four Required EOC Subject Exams, 1998-1999	The four required subjects for all students are: Algebra I, biology, ELPS, and U.S. History for the 1998-1999 academic year. This variable is the average of the four test scores = ((Algebra I + biology + ELPS + U.S. History)/4). Source: Variable generated by the author.

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VARIABLE	DESCRIPTION
Public School Dropout Data, 1998-1999: Grades 9th - 12th Duplicated Dropouts	A dropout is a student who leaves school before graduation or completion of a program for any reason except death or transfer. Beginning in the 1998-'99 academic year, the NC Board of Education began reporting the duplicated number, which records all dropouts regardless if they have been previously recorded. The figures include charter dropouts. Source: *The North Carolina Statistical Profile, 2000* www.ncpublicschools.org/fbs/stats/pdf/2000p2.pdf
Highest Degree Held by Instructional Personnel and Teachers with No Prior Experience	Percent of teachers by school district. Instructional personnel include: all professional educators with direct instructional responsibility such as principles, teachers, librarians, guidance counselors, and supervisors of instruction (p. 33). Source: *The North Carolina Statistical Profile, 1999* www.ncpublicschools.org/fbs/stats/pdf/1999p2.pdf
Parent Education Level of Student's Taking EOG Exams, 1998-1999: Did Not Finish High School; High School Graduate; Trade/Business School; Community College; Four Year College; and Graduate School	The percent of students taking the EOG exam with parents of corresponding education level, by LEA Source: North Carolina Department of Public Instruction, non-published information.
Children Age 5-17 in Poverty in 1997	Percent of school aged children (5-17) related to the head of household and below the poverty line by school district in 1997. Source: *U.S. Census SAIPE School District Estimates, 1997* www.census.gov/hhes/www/saipe/school/sd97ftpdoc.html
Median Household Income	Median household dollar income by school district. Figures are U.S. Census 1997 model-based estimates. Source: *2000 U.S. Census* www.quickfacts.census.gov/qfd/states/37000.html
Adults over 25 with College Degree, 1990	County percent adults over 25 with college degree in 1990, listed by school district. Source: *North Carolina Dept. of Commerce, 2000 County and Regional Scans* www.commerce.state.nc.us/econscan/county.asp
Population Density	County measure of population per square mile in 2000, listed by school district. Source: *North Carolina Dept. of Commerce, 2000 County and Regional Scans* www.commerce.state.nc.us/econscan/county.asp

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